

APPENDIX C

WHITEMARSH

ENVIRONMENTAL SYSTEMS, INC.

A Middlesex Water Company Affiliate

February 13, 2020

Via electronic mail and delivery service

Mr. Darrin Gordon
General Manager
Lewes Board of Public Works
107 Franklin Avenue
Lewes, DE 19958

RE: Report of findings - Lewes Wastewater Treatment Plant bypass of partially treated wastewater in December 2019

Dear Mr. Gordon:

Please consider this a letter report of our response and findings to date of our internal investigation with regards to the referenced matter. As previously reported to you, we have engaged a professional engineering consulting firm to perform an analysis of the incident including the broken membrane module described in item number 5 below. The results of that analysis are not expected to be complete for several weeks. The scope of that analysis is not to identify other contributing factors, but to confirm the contribution level of the membrane module failure to the bypass incident. We believe our internal investigation has rightfully concluded that all parties in the matter contributed to the bypass. **NOTE 1**

1. Sequence of events - Please refer to Attachment A for the timeline of events from December 19, 2019 through January 7, 2020.
2. Creation of Incident Command System - White Marsh Environmental Systems, Inc. (WMES) utilizes the Incident Command System (ICS). The below ICS structure was set up on December 19, 2020.
 - a. Overall Incident Commander- Paul Peris (WMES) with back-up by Bruce Patrick (WMES)
 - b. Maintenance Logistics - Justin Illian (WMES) with back-up by Neil Gerardi (WMES)
 - c. Operations Logistics - Mike Evans (WMES) with back-up by Jeff Deats (WMES)
 - d. DNREC Contact - Paul Peris
 - e. BPW Contact - Bruce Patrick
 - f. Membrane manufacturer (Zenon or Suez) Tech Support Contact - Ron Griffith (WMES)
 - g. Suez New Membrane Contact - Jeff Deats

3. Bypass Sampling Results per DNREC requirement - Please refer to Attachment B for the required bypass sampling results that have been submitted to DNREC.
4. Summary of the bypass flow dates and totals:
 - a. 3,920,300 gallons
 - i. December 19th 2019 at 6:35pm bypass started
 - ii. December 28th 2019 at 5:00pm bypass stopped
 1. Bypass ran for 9 days. Total running hours - 207 hrs. 25 min.
 - iii. January 1st 2020 at 9:45pm bypass started
 - iv. January 1st 2020 at 11:45pm bypass stopped
 1. Bypass ran for 2 hrs. during membrane shutdown
5. Cause of failure on December 19, 2019 - A broken membrane module was removed from Train #2. There was a broken lock mechanism on the membrane module {see Attachment C - picture}. In addition, the needle valve leading to the turbidity meter on Train #2 plugged with mixed liquor when the membrane module broke and prevented the protection system from shutting the process down. This allowed mixed liquor to be drawn into the permeate tank and subsequently back pulsed into all the membrane modules causing a complete shutdown. **NOTE 2**

There are a number of factors that appear to have contributed to the membrane failure. These factors include, but are not limited to:

- a. The membranes are approximately 14 years old and near the end of their useful life. This undisputed fact has been acknowledged by both Suez and the Lewes Board of Public Works {BPW}. In addition, the 2016 report from Severn Trent recommended that the membranes be replaced. **NOTE 3**
- b. Suez indicated during its January 7-9, 2020 inspection of the plant that the number of chemical soaks/cleanings over a period of years adds wear and tear to the membranes and weakens the integrity of the plastic hardware, making the membranes and plastic hardware supporting the membranes more susceptible to failure. It was the failure of the plastic hardware on a membrane module that was a contributing factor in the event. **NOTE 4**
- c. Prior failure: on April 2, 2019 WMES notified the BPW via email (See Attachment D) that plastic hardware failed on a membrane module in Train #2, and that fatigue and age of the membrane module plastic hardware was the cause of this failure. This report has not been disputed. **NOTE 5**

- d. Prior failure: the October 2019 WMES report to BPW requested BPW approval to order more blanks for use when the membranes break and indicated that the last set had been used. Attachment E contains an excerpt from this report. **NOTE 6**
 - e. Prior failure: the November 2019 WMES monthly report to BPW indicated that train #3 had a broken cartridge that was replaced with a blank. Attachment F contains an excerpt from this report. **NOTE 7**
 - f. Plant configuration and control: Suez claimed in their January 2020 report that the system set points for turbidity are to be 2 NTU for notification and 5 NTU for train shutdown. The Operation and Maintenance Manual relative to the membranes provided by Suez, which remains on-site at the Lewes Wastewater Treatment Plant and was provided to White Marsh by the BPW upon commencement of operations by White Marsh, does not delineate recommended set points. In addition, the Control Logic Summary Chart (CLSC) supplementary document to the Operation and Maintenance Manual located at the facility does not contain the above-referenced system set points. See Attachment G for O and M Manual excerpt. An updated O and M Manual should be provided. **NOTE 8**
 - g. Ten of the twelve membrane cassettes had membrane modules installed above aerator blanks. This was confirmed by Suez during their Jan 7-9 2020 inspection and was attributed to actions by the previous operations company. Installation of the membranes at this location would prevent air from properly scouring and cleaning the membranes. **NOTE 9**
 - h. At a November 9, 2017 meeting, the minutes to that meeting reflect that the BPW indicated the membranes were budgeted to be replaced in 1.5 years. **NOTE 10**
 - i. Suez reported that the previous plant operator stopped work (cleaning the membranes) upon expiration of its operating contract in 2016. In March 2017, shortly after the beginning of White Marsh's tenure as Plant Operator, BPW representatives physically inspected the plant and directly observed that the membranes were in a significantly deteriorating condition. **NOTE 11**
 - j. Maintenance History-Train number 4 membranes were manually cleaned in 2019. Trains 1, 3 and 4 also had chemical recovery cleans in June, May and August respectively. Auto-scheduled Maintenance cleans were performed based on the PLC program set-points. **NOTE 12**
6. Cause of 2 hour bypass on January 1, 2020. The pressure increased from 1.5 to over 5 psi at 7:00 p.m. in the new membranes (train #2). After consultation with Suez, it was determined that with only one train in operation that there may be more sludge buildup on the membranes than

normal. WMES operators recirculated the flow out from train #2 for 15-20 minutes and after sludge circulation the membranes started to permeate and function.

7. OSHA reportable accident - A reportable OSHA accident occurred on December 21, 2019, when the unsecured grating above Train #2 shifted and an employee fell into the empty tank. An investigation was performed and temporary safeguards have been put in place.
8. Non-reportable accident - On December 2, 2019, a grate shifted and an employee slid into the wastewater on train #3. This did not result in an OSHA reportable accident. An investigation of the December 2nd incident was completed. Recommendations from the report were not implemented prior to the accident on December 21. **NOTE 13**
9. Plans for Corrective Actions:
 - a. Equipment
 - i. Installed 4 new turbidity meters with new controllers.
 - ii. Installed a turbidity probe in permeate tank
 - iii. Verification of set points and an O and M Manual with correct set points has been requested.
 - iv. Consideration is being given for a second permeate tank.
 - v. In addition, the needle valve leading to the turbidity meter plugged when the membrane module broke. Due to the high concentration of mixed liquor suspended solids that were pulled in thru the 1/4" sample line and flow control needle valve, this incident would have happened regardless of the turbidity meter settings. There appears to be a design flaw in the monitoring system as this is possible anytime that the membrane hardware breaks allowing mixed liquor to be pulled in. In order to provide a failsafe option in the event that a module breaks, the design of the turbidity meter should be reevaluated and a different style proposed that reduces or eliminates the risk of a needle valve becoming plugged. **NOTE 14**
 - b. Communication
 - i. WMES District Manager is to be direct contact with BPW General Manager. In the interim, WMES Director of Production and Maintenance will assume this role until further notice. During emergency events, WMES utilizes the ICS system and **will** set up a structure as indicated in #2 above.
 - c. Training - A level IV operator licensed by the Delaware Board Certification for Wastewater Operators (Board) is the DRC of the facility. All WMES licensed operators attend training classes for continuing education credits as required by the Board. Specific training for the Suez Zeeweed membrane system at the Lewes WWTP will be part of the WMES 2020 training program.

The above-referenced factors all contributed to the failure of the membranes. WMES is committed to working with the BPW to ensure that such an accident doesn't happen again.

In a spirit of cooperation

and collaboration, we hope that the BPW, WMES and Suez can come to a shared understanding of their respective responsibilities relative to the cause or causes of this incident and that we can resolve any disputes amicably.

Should you have any questions, please feel free to contact me at 302-747-1336.

Sincerely,

f,

Bruce E. Patrick, P.E.
General Manager

Ecc: A. Bruce O'Connor
Paul Peris

BPW COMMENTS ON WMES REPORT

Note 1 – BPW does not agree with the statement that all parties contributed to the events leading to the bypass. BPW contracted with WMES for their expertise in operating waste treatment facilities, and pursuant to the terms of the contract, WMES was responsible for the safe and effective management of the plant.

Note 2 – The data log clearly shows that the turbidity had increased through the alarm and isolation set-points as a result of the break with no action from the plant or plant operators since the set-points had been set to top of scale. It was only after the train should have isolated at 5 NTU that the flow was lost to the turbidity monitor due to fouling.

Note 3 – The membranes had been in service for approximately 11 years. While the Severn Trent report recommended replacement, Suez was on-site in 2017 and recommended mechanical cleaning of the filters but concluded based on performance that the filters were not in need of replacement.

Note 4 – What Suez actually reported was that the **Cassette** hardware had a useful life of 13-14 years but that the membrane module had a longer life. The failure that occurred was of the lock tab on one of the membrane modules.

Suez explained that the life of the membranes is a cost/benefit analysis based on how much permeability is recovered after proper cleaning. In other words, the membrane's "useful life" has nothing to do with the type of failure that occurred in December 2019. Suez also stated that the cause of failure was over stressing of the membrane assemblies due to the excessive sludge buildup. Suez has not experienced catastrophic failures of membranes without excess stress.

Note 5 – The email chain included by WMES was not complete. It did not include the response from where Darrin Gordon (2:46 PM) when asked "Anything else we need to do at this time?" or the response from WMES (4:10PM) stating "I will keep you posted on membrane status." There was no further communication from WMES.

Note 6 – BPW had been pressing WMES since at least December 2018 to perform mechanical cleanings, there are numerous e-mails that document that BPW had authorized the cleaning. In addition, chemical and mechanical cleaning of the filters is part of standard routine maintenance of the filters as called out in the Suez Operation and Maintenance Manual and should have been part of WMES standard preventative maintenance.

Note 7 – WMES monthly report only states "repair membrane #3" since there was no emphasis on it, it was assumed this was a routine plugging of a filter strand or other non-critical issue.

Note 8 – In addition to Note 2, The electronic copy of the Operation and Maintenance manual contains the setpoints both in the CLSC and it is also in Section 5.12. When Suez first looked at the set-points they found both the alarm and isolate set to 10 NTU. The

BPW COMMENTS ON WMES REPORT

next day when Suez returned to site, they found them reset to their correct set-points of 2 and 5 NTU. This strongly suggesting the correct set-points were known to the operators.

The complete CLSC is 33 pages, the hard copy that was in the control room was only 7 and thereby was probably an addendum provided post start-up for changes.

If WMES did not have the complete manual; as the operator of the plant they should have requested it from either BPW or Suez

In 2017 upon taking over the contract in March 2017, Suez provided an overview course to the operators to explain how the system operated and how to read the control documentation.

Note 9 – The “Ten of the twelve membrane cassettes” while technically correct does not represent the actual configuration and grossly overstates the impact on the membranes. In addition, the worst-case outcome of this would have been an increase in the cleaning frequency of the filters.

Note 10 – The BPW uses a conservative method for budgeting. While the replacement of the filters was in the capital plan, discussion with Suez indicated that replacement was not necessary in the immediate term.

Note 11 – The statement “...significant deteriorating condition.” was with respect to the sludge buildup and not the physical condition of the membranes. Suez indicated in their 2017 report that the filters needed to be “de-ragged”, that is mechanically cleaned

Note 12 – While train 1,3, and 4 did receive chemical cleaning, the data shows there was little to no recovery of permeability. This was due to the excessive sludge buildup preventing the chemical from cleaning the membranes. This should have been another indication of the need to mechanically clean the filters.

Note 13 – Why were the recommendations of the 1st near miss investigation from 2 December 2019 not implemented?

Note 14 – See note 2, if the set-points had been correctly set, the system would have isolated and protected the remaining three trains.